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Hot-embossing of microstructures on addition-curing PDMS films

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Abstract

The aim of this research work is to establish a hot-embossing process for addition curing vinyl terminated PDMS (polydimethyl siloxane) which are thermosetting elastomers, based on the existing and widely applied technology for thermoplasts. Addition curing silicones are shown to possess the ability to capture and retain an imprint made on it 10-15 minutes after the gel-point at room temperature. This property is exploited in the hot-embossing technology. (Figure 1)

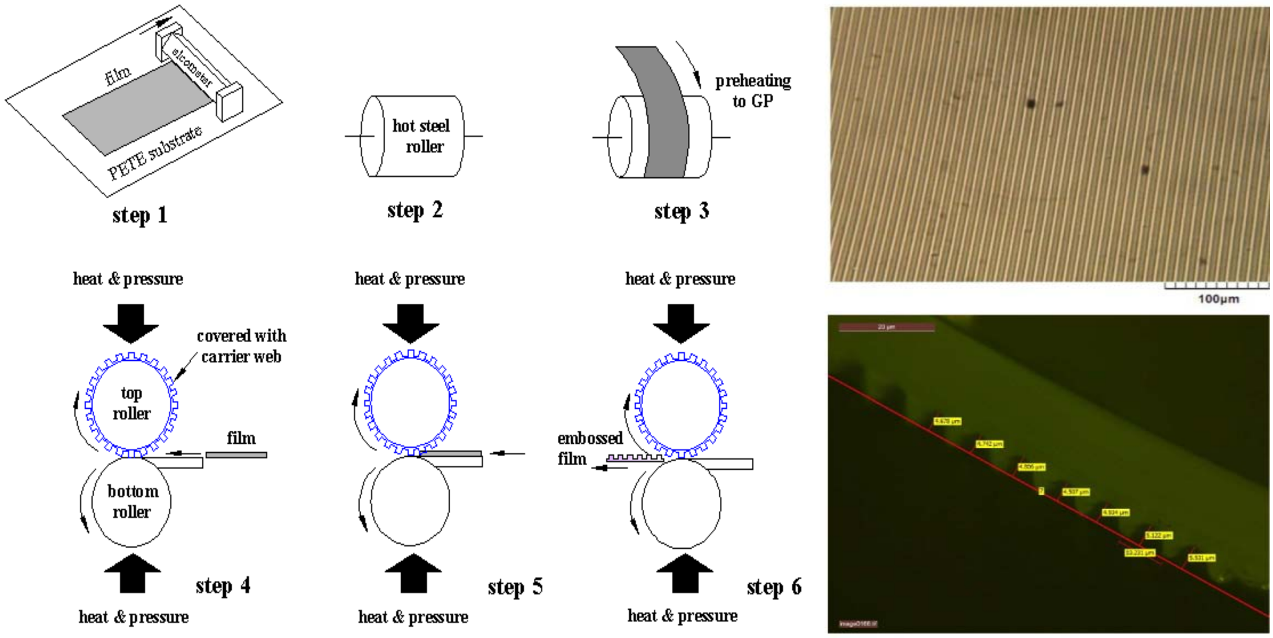

Figure 1: Schematic of the Hot-embossing process (left). Embossed film (100μm) under microscope (right)

In the large scale manufacture of dielectric electroactive polymers (DEAPs) by Danfoss Polypower A/S, the surface of the PDMS elastomer films are imparted with micro-scale corrugation lines which enhance the performance of the films as actuators and generators due to the directional anisotropy and it allows for high strains of the metallic electrodes. [1,2] The films are currently made on a specially designed carrier web which imparts the corrugated structure to the films. The elastomer mixture is applied on the carrier web and it is left to cure on the web. The cured elastomer film is then peeled off the web to allow for the deposition of electrodes. This process is expensive, as it requires miles of carrier web to make the films. Therefore an alternative process to make thin, corrugated elastomer films is required to make the DEAP technology economically competitive with other actuator, generator and sensor technologies. The hot-embossing process is one of the simplest, most cost-effective and time saving alternative method for replicating micro-structures on addition-curing PDMS films.

Keywords: Embossing, elastomer, gel-point, DEAP, PDMS, carrier web.

References:

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[2] Benslimane, M.Y., Kiil, H. and Tryson, M.J. (2010). Dielectric electro-active polymer push actuators: performance and challenges. Polym. Int.59 (3): 415–21.